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(54) Premixed gas burner

(57) A premixed gas burner has a hollow body (12,212) including a closed end (48,248) and an entry end (14) into which a combustible gas and air mixture may flow. The body has a multiplicity of apertures (34,234) through which the mixture may pass from the hollow interior. A burner portal deck (54,254) is positioned in superposed relationship over the apertures for permitting the gas air mixture to form a controlled flame. A porous woven fabric (60,260) formed from ceramic fiber having high thermal insulation properties is located above the deck and separates the deck from the flame front formed when the mixture is ignited. The fabric insulates the deck from excessive temperatures, prevents flash back, allows use of conventional stainless steel for the deck and body components and makes possible the manufacture of long burner sections. A long burner section has a number of decks in side-by-side relationship with an insulating fabric mat over the decks for not only providing insulation, but also forms a gasket between the adjacent decks.

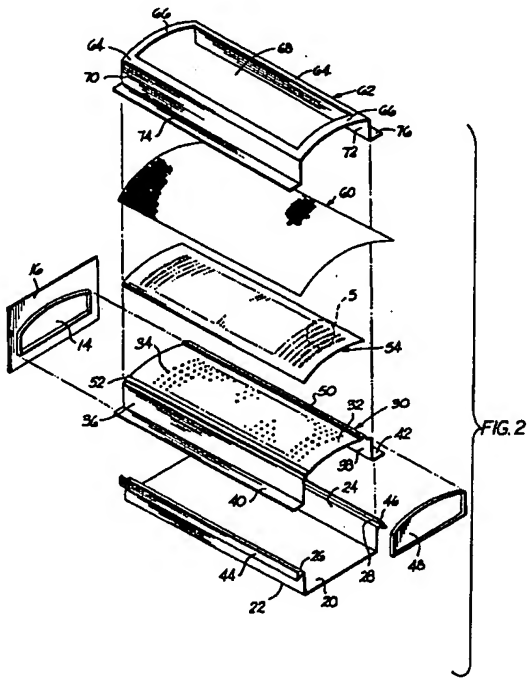

FIG. 2

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Description

BACKGROUND OF THE INVENTION

This invention relates to a premixed gas combustion burner, and more particularly to a burner system which is capable of a high degree of modulation and has the high mechanical strength of a metal burner with the thermal stability of a ceramic burner.

Premixed gas burners used in boilers, heat pumps, hot water heaters and other applications provide a high heat release in a small area while providing low pollutant gas combustion product emissions. Generally such premixed gas burners comprise a hollow body having a closed end and an open end into which the premixed gas flows. The burner body includes at least a portion which has a multiplicity of holes through and out which the gas and air mixture from the interior of the body flows. Another member which has the burner flame port perforations, and which in the case of cylindrical burners such as that disclosed in Canadian Patent No. 1,303,958, may be a coaxial shell, or in certain designs may be a substantially planar member known as a deck, is spaced outwardly or downstream from the body of the burner. In the prior art, no effective insulation has been provided between the outlet of the flame port perforations and the combustible mixture within the body.

Premixed gas combustion flames are short with the flame front just beyond or above the burner port or deck surface. Normally the mixture has approximately 30 percent excess air so as to provide cleaner combustion products. At loadings, i.e., heat per unit area, below approximately 6 kilowatts per square decimeter, the burner port surface will be radiant since the velocity of the mixture is low resulting in the flame being positioned on or closely adjacent to the surface. This gives rise to problems of thermal fatigue and high temperature oxidation of the burner port surface or deck, and potential flashback of the flame into the burner body. At higher loadings, e.g. approximately 12 kilowatts per square decimeter and above, the increase in volumetric flow is such that the velocity of the mixture may be increased to the point where the flame front is further from the burner port surface resulting in a blue flame and the surface of the burner ports material is relatively cool so that a burner port surface material comprising stainless steel may be used without insulation. However, even at such higher loadings if the amount of excess air is not or cannot be controlled resulting in inadequate excess air, burner surface overheating may yet result. In certain applications, such as domestic hot water heaters, high loading is desired. In other applications, however, modulation between high and low loadings are desired. The low burner loadings, however, as aforesaid, result in the burner port surface or deck becoming radiant.

Certain of the aforesaid problems have been addressed by the use of a high temperature grade of stainless steel, or more exotic high temperature materials such as Aluchrome, Haynes 230 and other expensive exotic materials. While such materials may withstand high temperature oxidation, and possibly also degradation due to thermal stresses if the assembly permits expansion and is therefore forgiving, the potential for flashback of the combustible mixture is greatly increased since such metals are excellent conductors of heat. Thus, the temperature on the upstream side of the burner port surface may be substantially the same as that on the downstream side, i.e., the temperature beneath a deck may be the same as the temperature on top of the deck. In that case, the temperature of the gas mixture may be raised toward the auto-ignition temperature before the mixture passes through the burner ports.

A known premixed burner devised to overcome these problems utilizes a metal fiber material formed from an alloy of iron, chromium, aluminum and yittrium applied to the burner port surface or burner deck. The metal fiber material must have a port construction identical to that of the deck. Thus, to produce this structure both the metal fiber structure and the deck, which is constructed from stainless steel, must be perforated simultaneously. The metal fiber product provides an insulating feature due to the porosity of the structure. When perforating the metal fiber material simultaneously with the stainless steel deck, the fibers tend to be compressed and the porosity of the structure is reduced. Consequently, the conductivity of the material is increased and the protection is reduced or lost. Problems in producing this system include maintaining the stainless steel deck and the metal fiber perforations aligned, and a tendency to intermittently attach the metal fibers to the burner deck by cold welding in the ports. In operation, the metal fiber structure is prone to erosion due to the slightly acidic nature of the water vapor in the combustion products. Additionally, the maximum safe operating temperature of this material is very close to the actual operating temperatures of the burners in practice, especially when propane gas is used as the fuel. Another difficulty with the use of metal fibers is that it relies on the formation of a protective aluminum oxide coating, and the coating may not properly form or may even break down if the appliance within which the burner is used is operated incorrectly, such as in a reducing atmosphere.

SUMMARY OF THE INVENTION

Consequently, it is primary object of the present invention to provide a premixed gas combustion burner having the mechanical strength of a metal burner with the thermal stability of a ceramic burner.

It is another object of the present invention to provide a premixed gas burner having a thermal insulator disposed for lowering the temperature of the burner port surface thereby to minimize the potential for flashback of the combustible mixture.

It is a further object of the present invention to provide a premixed gas burner having a thermal insulator in

the form of a porous fabric formed from fibers having high thermal insulation properties disposed on the downstream surface of the burner port deck, the flame front being on the downstream side of the fabric for limiting transfer of heat from the flame front back to the deck so that a high degree of heat load modulation may occur without encountering thermal fatigue and high temperature oxidation of the deck or flashback of the combustible mixture within the body of the burner.

It is a still further object of the present invention to provide a premixed gas burner having a thermal insulator in the form of a porous ceramic fiber fabric readily disposed on the downstream surface of the burner port deck which does not corrode as a result of components of the combustion products nor break down in operation, and which limits the transfer of heat back to the deck.

Accordingly, the present invention provides a premixed gas burner having a hollow body including a closed end and an entry end into which a combustible gas mixture is directed, the body having apertures through which the gas mixture is distributed, a burner port deck being positioned in superposed relationship relative to the apertures for throttling the gas mixture to provide a flame front when the mixture is ignited, and the burner having a porous fabric formed from fiber with high thermal insulation properties disposed on the downstream side of the deck to separate the deck from the flame front and insulate the deck from excessive temperatures, and thus prevent flashback, allow the use of inexpensive ferritic stainless steel and make possible the manufacture of long burner sections.

In the preferred form of the invention the fibers from which the fabric is constructed comprise ceramic fiber, which is substantially chemically inert, and therefore is not susceptible to high temperature corrosion due to the acidity of water which may be present in the combustion products. The fiber fabric is supported and held in contact with the deck by a retention member which applies pressure to the fabric against portions of the deck which do not have the ports so as not to constrict the flow of the combustion products through the deck or fabric. In operation the fabric contacts the deck so the deck and fabric act as a unitary structure.

When used with a long burner the deck may be segmented and with the fabric insulator formed as a continuous member, the fabric not only acts as an insulator but also as a gasket between the segmented sections of the deck.

BRIEF DESCRIPTION OF THE DRAWINGS

The particular features and advantages of the invention as well as other objects will become apparent from the following description taken in connection with the accompanying drawings in which:

Fig. 1 is a perspective view of a premixed gas burner constructed in accordance with the principles of the present invention;

Fig. 2 is a disassembled perspective view of the burner illustrated in Fig. 1;

Fig. 3 is a cross sectional view taken substantially along line 3-3 of Fig. 1;

Fig. 4 is an enlarged view of a fragmentary portion of the burner deck as illustrated in Fig. 2;

Fig. 5 is a view similar to Fig. 2 but illustrating a long burner with a segmented deck;

Fig. 6 is a perspective view of a cylindrical premixed gas burner constructed in accordance with the present invention; and

Fig. 7 is a cross sectional view taken substantially along line 7-7 of Fig. 6

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings, a premixed gas burner **10** constructed in accordance with the principles of the present invention comprises a hollow body **12** through which a premixed combustible gas mixture may flow, the body having an inlet **14**, illustrated in Fig. 2, preferably disposed within a flange **16** adapted to be fastened to an appliance in which the burner is used. The body **12**, as in the preferred embodiment, may be an elongated structure comprising a base **18** in the form of a trough having a central wall **20** and a pair of substantially parallel side wall **22, 24** extending outwardly from the wall **20** and terminating at lips **26, 28** extending outwardly from the respective wall **22, 24**. Disposed over the base **18** is a distributor member **30** having a wall **32** overlaying the wall **20** of the base **18**, the wall **32** of the distributor having a multiplicity of perforations or holes **34** through which the gas mixture may exit from within the hollow of the body **12**. The distributor member **30** also includes a pair of side walls **36, 38** extending therefrom which side walls terminate at lips **40, 42** adapted to abut the lips **26, 28** respectively of the base. A flange **44, 46** on the end of each lip **26, 28** of the base may be folded onto the lips **40, 42** respectively and clinched or spot welded thereto to unify the body **12** with an end closure cap **48** therebetween at the end remote from the inlet **14**, the cap **48** and flange **16** about the opening **14** being welded to the distributor member and body. Thus, a hollow burner having an inlet through which combustible gas may enter and having exit openings **34** through which the gas may egress is provided.

Disposed on ridges **50, 52** outstanding from the outer surface of the wall **32** is a peripheral portion of the burner deck **54**. The deck **54** is highly perforated with the burner ports which preferably may include circular openings **56** and elongated slots **58** substantially equal in length to three openings as illustrated in Fig. 4, the ports being located in an array disposed within a substantially central area of the deck spaced from the periphery and superposed over the perforations **34** in the wall **32** of the distributor **30**. Thus, the combustible gas mixture exiting the perforations **34** flows through the openings **56, 58** and may be ignited.

Disposed on the surface of the burner deck **54** remote from the distributor **30**, i.e., the downstream surface of the burner deck in relation to the direction in which the gases flow, is a fabric cloth or mat **60** woven from fibers of thermal insulation material such as ceramic fibers. The ceramic fibers preferably may comprise 62% Al_2O_3, 24% SiO_2 and 14% B_2O_3 woven at 30 yarns per inch in the warp direction and 15 yarns per inch in the fill or weft direction. The thickness is approximately 0.041 inch with a weight of 23.43 ounces per square yard. This provides optimum insulation with low pressure drop. The fiber have a density of approximately 2.7 gm/cc and a diameter of 10 to 12 micron. A cloth or mat woven from fiberglass fibers may also have the required thermal insulation properties. A retainer **62** in the form of a frame having opposed side and end rails **64, 66** respectively disposed about a central opening **68** substantially of a size and configuration as that of the portion of the burner deck having the array of ports **56, 58** is located on the downstream surface of the fabric **60** to retain it tightly against the surface of the deck **52** outwardly of the ports **56, 58**. The retainer **62** includes a pair of depending legs **70, 72** which overlay and abut the side walls **36, 38** of the distributor **30** and preferably includes lips **74, 76** which may be disposed between the lips **40, 42** of the distributor **30** and the flanges **44, 46** of the base **18** and be clinched or welded thereto. Additionally, the ends of the rails **66** may be clinched or welded to the end cap **48** and the flange **16** so that the retainer is secured to the body of the burner and retains the fabric **60** against the deck **54**.

In operation, premixed gas and air enter through the inlet **14** of the flange **16** under pressure created by a blower or the like (not illustrated) in the appliance in which the burner is mounted. The mixture is disbursed evenly throughout the burner by the perforated baffle created by the wall **32** of the distributor **30** which creates a high pressure drop and is closely spaced, e.g. approximately 2.5mm, from the burner deck **54**. The mixture then passes through the burner deck ports **56, 58** and through the fabric **60** which, because of the close proximity thereof created by the clamping action of the retainer **62**, act as a single member. The mixture may be ignited to burn above the burner deck and ceramic fabric combination. The ceramic fibers have a very low thermal expansion coefficient, approximately $3x10^{-6}$ per deg. C and, therefore, the stainless steel deck beneath the fabric when it expands, abuts the ceramic fabric which remains relatively stationary. The fabric and the stainless steel deck thereby act as a unitary member.

When the loading of the burner is reduced below about 10 kilowatts per square decimeter the surface of the ceramic fabric **60** becomes radiant. Because of the low thermal conductivity and porous nature of the woven ceramic fabric, the temperature on the underside of the fabric is substantially lower than the temperature on the upper surface. Thus, the temperature on the burner deck is kept well below the autoignition temperature of the gas/air mixture. The temperature differential between the upper surface of the ceramic mat and the lower surface of the ceramic mat may be approximately 400°C when the upper surface is in the range of 750°C to 950°C. The temperature, even under worst case conditions, on the burner deck is generally maintained below 500°C. The burner deck/ceramic fabric combination is extremely stable even at high excess air factors of about 60% excess air and loadings 15 kilowatts per square decimeter because part of the mixture tends to burn in the ceramic fabric causing small radiant sections throughout the burner surface.

When constructing a long burner, the burner deck, as illustrated in Fig. 5, may be segmented or formed from a number of the burner decks **54** and allowed to float lengthwise when expansion occurs. The ceramic fabric **60**, however, as illustrated in Fig. 5, is a continuous mat which acts as a gasket between the segmented burner deck pieces. The retainer in this case is an elongated structure **162** having a plurality of central openings **168** each corresponding to one of the burner decks **54**. Such long burners may be required in some applications, for example, in steam boilers for commercial applications. In such case a burner of approximately five feet may be required. Since the decks are fabricated from stainless steel which has a high coefficient of thermal expansion, the deck is segmented into sections of approximately ten inches. However, the mixture normally can flow through the gap between the segments which would result in an uncontrolled and noisy flame. The ceramic fiber fabric thus acts as a seal or gasket in addition to insulator in this embodiment and prevents the gases from forming the uncontrolled flame.

Referring to Figs. 6 and 7, a cylindrical premixed gas burner is illustrated having a body **212**, which may receive premixed gas and air through an inlet **214** at one end of the body opening into an entrance in a mounting flange **216**. An end cap **248** opposite to the inlet **214** acts as a closure member to close the body which includes a multiplicity of holes **234** through which the mixture may egress and be distributed. A burner deck **254** is spaced radially outwardly from the body **212** by means of annular ribs **250** (only one of which is shown) at each end of the body, the deck **254** having the ports which preferably include circular openings **56** and elongated slots **58** such as that illustrated in Fig. 4 in regard to the earlier embodiments. An insulating mat **260**, formed from an insulating material as heretofore described, in the form of a cylindrical sleeve, is positioned about the deck **254**. The sleeve **260** is retained tightly against the outer surface of the deck **254** by an interference fit provided by radially inwardly compressing the outer periphery of the deck **254**, positioning the sleeve about the deck and thereafter permitting the deck to spring outwardly to retain the sleeve tightly against the deck. In all other respects this embodiment is substantially identical to those heretofore described.

Numerous alterations of the structure herein disclosed will suggest themselves to those skilled in the art. However, it is to be understood that the present dis-

closure relates to the preferred embodiment of the invention which is for purposes of illustration only and not to be construed as a limitation of the invention. All such modifications which do not depart from the spirit of the invention are intended to be included within the scope of the appended claims.

Claims

1. A premixed gas burner comprising, a hollow body member (12) having an inlet (14) for receiving a combustible mixture of gas and air and outlet means (30), said outlet means comprising an outlet area (32) of said body member having a multiplicity of apertures (34) through which said mixture may flow, a burner portal deck (54) having first and second surfaces disposed with said first surface in close proximity to said outlet area, said deck having a multiplicity of burner ports (56,58) extending through said surfaces and disposed in an array superposed over said apertures for permitting said gas and air mixture received from said body member to flow from said first surface to said second surface, characterized by a thermal insulator in the form of a porous woven fabric mat (60) disposed on said second surface of said deck permitting said gas and air mixture to flow therethrough and to be ignited to form a flame front at said second surface while limiting transfer of heat from said flame front to said deck, and retaining means (62) for holding said fabric against said second surface of said deck.

2. A premixed gas burner as recited in claim 1, characterized by said fabric mat comprising fibers having high thermal insulating properties.

3. A premixed gas burner as recited in claim 2, characterized by said fibers being ceramic material.

4. A premixed gas burner as recited in any of the preceding claims, characterized by said retainer means comprising a frame disposed in abutment with and secured to said body member, said frame having rails (64,66) abutting portions of said mat and having a central opening (68) disposed in superposed relationship over said array of ports.

5. A premixed gas burner as recited in any one of the preceding claims, characterized by said body member (212) and deck (254) being cylindrical members, and said mat is a cylindrical sleeve (260).

6. A premixed gas burner as recited in claim 1 characterized by a plurality of burner portal decks each having first and second surfaces disposed in side-by-side relationship with said first surfaces in close proximity to respective adjacent portions of said outlet area, each of said decks having a multiplicity of burner ports extending through said first and second surfaces and disposed in an array superposed over apertures in said respective portions of said outlet area for permitting said gas and air mixture received from said body member to flow from said first surface to said second surface of each deck, said porous woven mat disposed on said second surface of all of said decks, and said retainer means (162)clamping said fabric against said second surfaces of all said decks.

7. A premixed gas burner as recited in claim 6, characterized by said fabric mat comprising fibers having high thermal insulating properties.

8. A premixed gas burner as recited in claim 7, characterized by said fibers being ceramic material.

9. A premixed gas burner as recited in any of claims 6 through 8, characterized by said retainer means comprising a frame disposed in abutment with and secured to said body member, said frame having rails abutting portions of said mat and having a plurality of openings (168) corresponding in number to the number of decks, each opening disposed in superposed relationship over and array of burner ports of a respective deck.

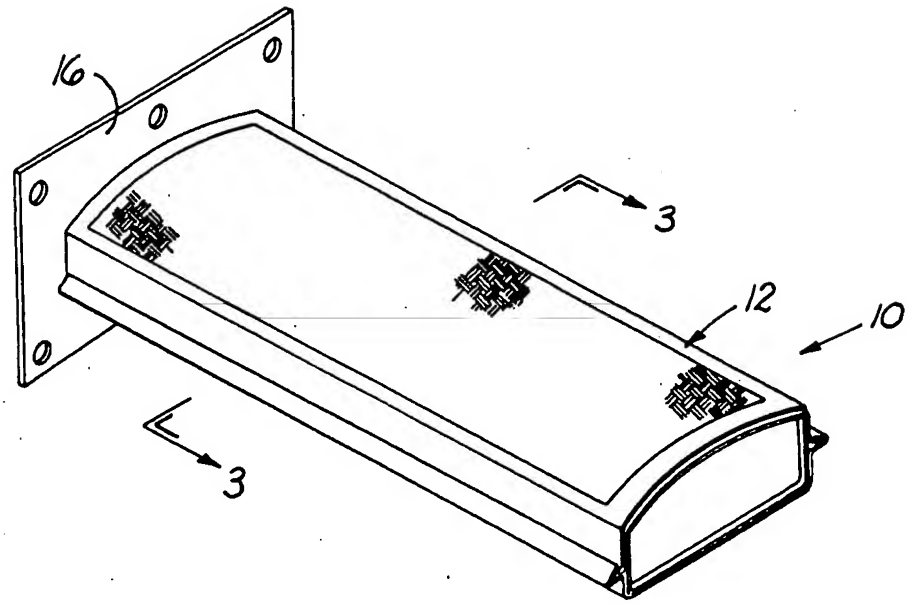

FIG. 1

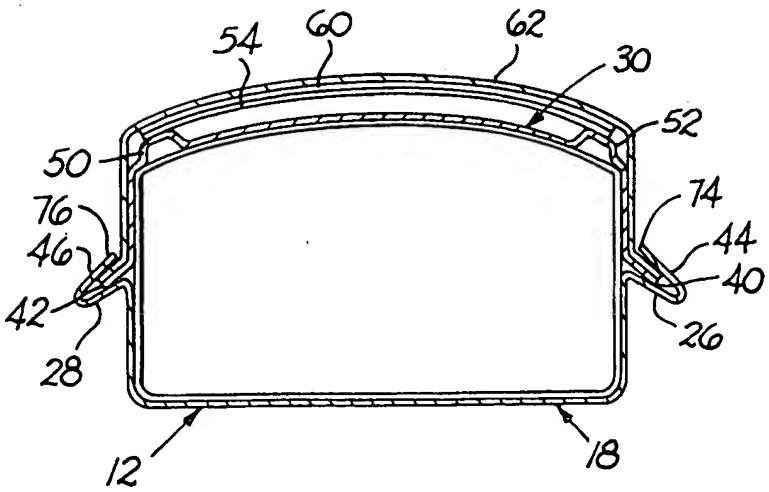

FIG. 3

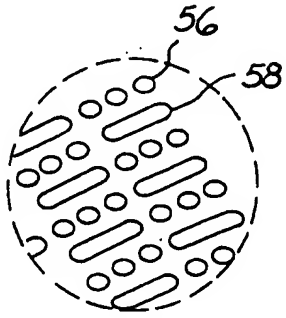

FIG. 4

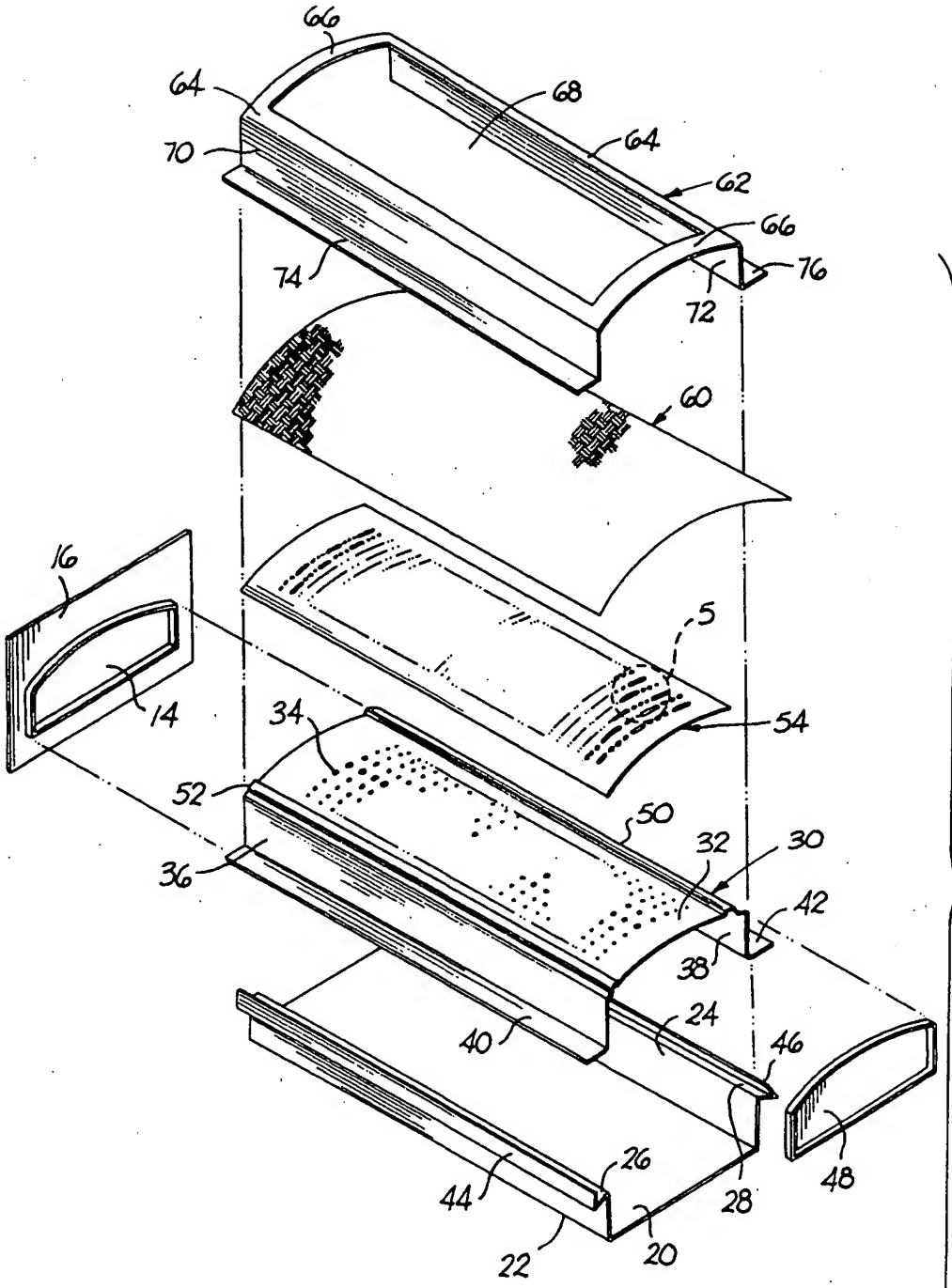
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FIG. 2

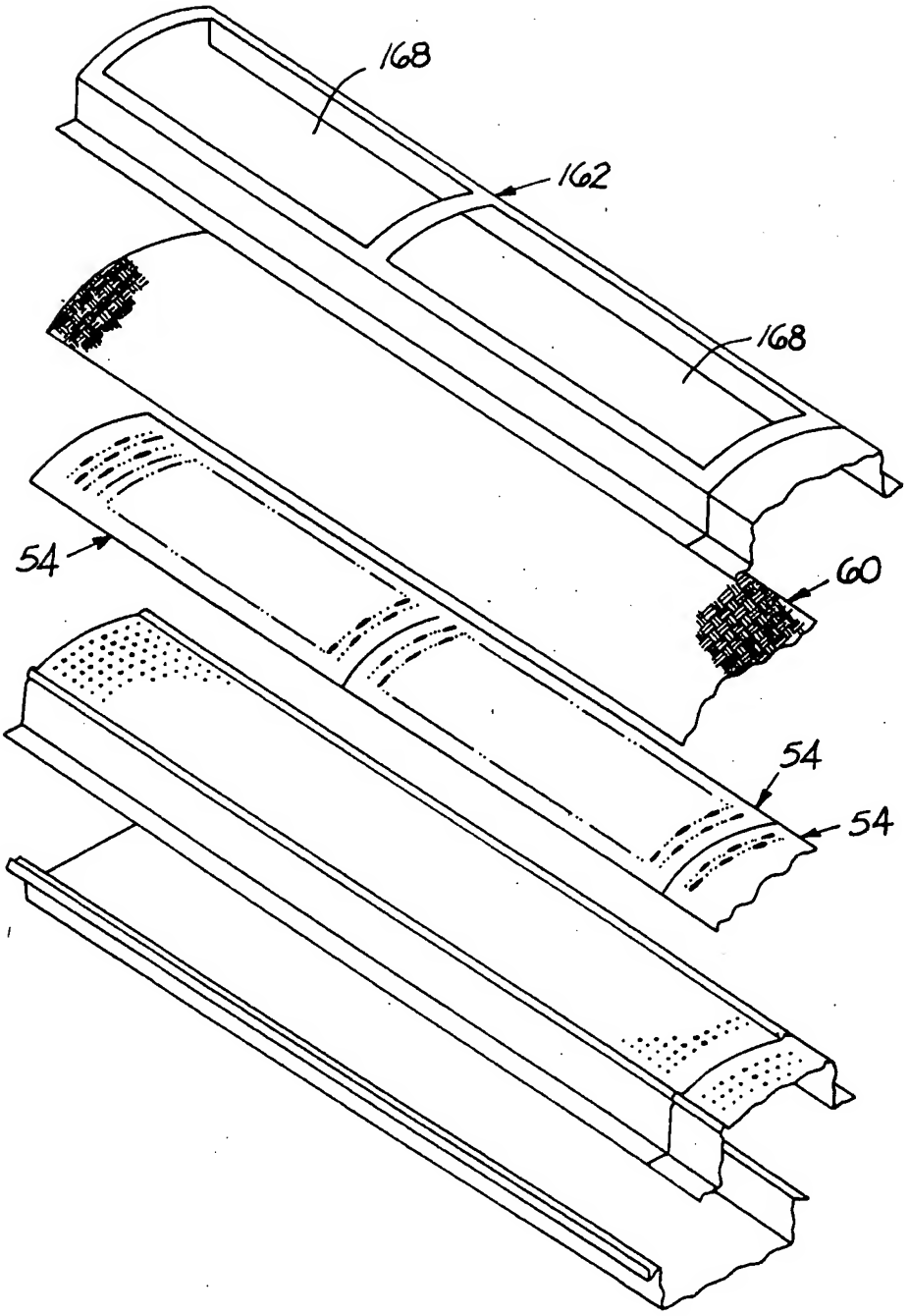

FIG. 5

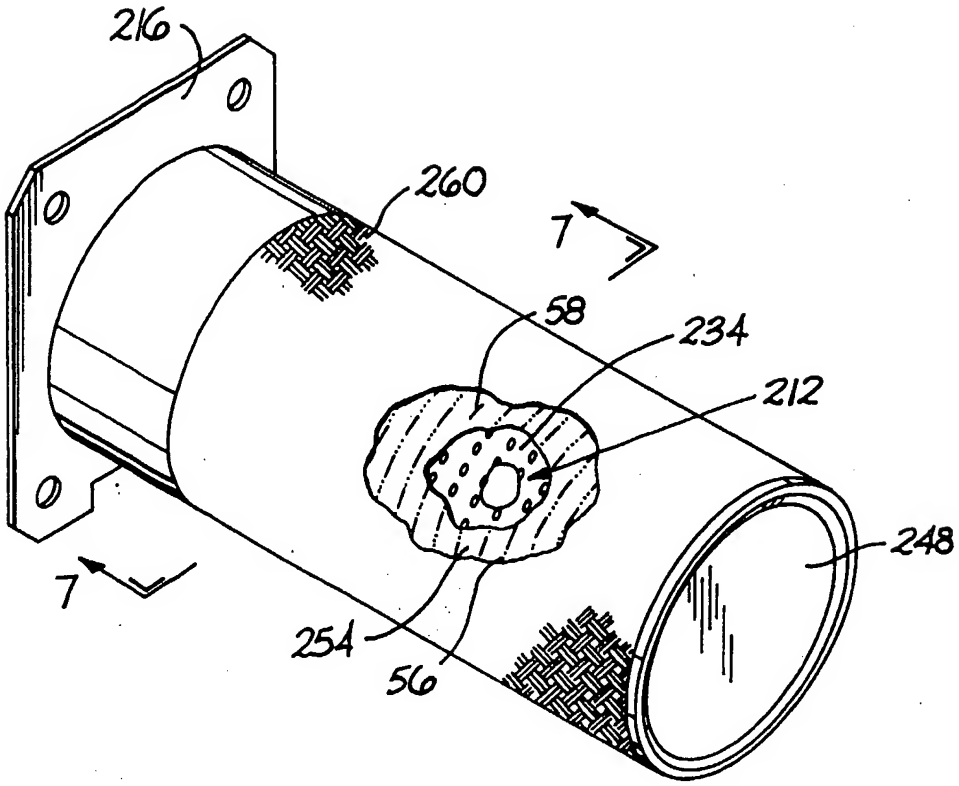

FIG. 6

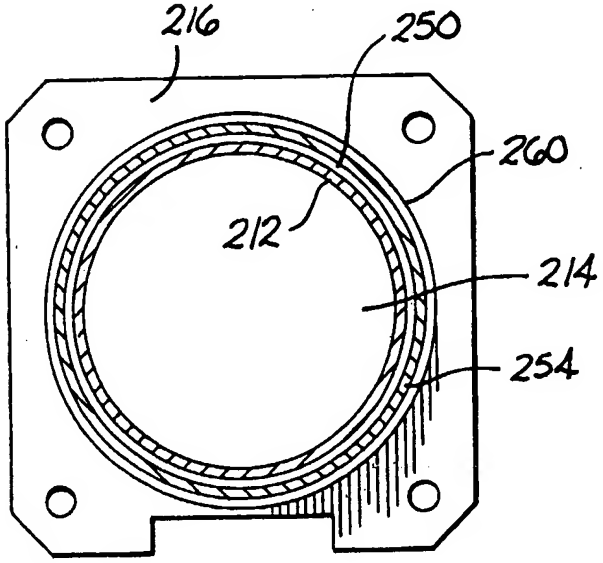

FIG. 7

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 96 10 8348

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	EP-A-0 245 084 (A.O. SMITH CORPORATION) * column 3, line 18 - column 3, line 40; figure 1 *	1-3,5	F23D14/02 F23D14/46 F23D14/82
A	GB-A-2 154 312 (A. O. SMITH CORPORATION) * page 1, line 117 - page 2, line 9; figures 1,2 *	1-3,5	
A	US-A-5 165 887 (AHMADY) * abstract * * column 5, line 27 - column 5, line 44 * * column 6, line 65 - column 7, line 28 * * figure 3 *	1-3,5	
A	US-A-4 657 506 (IHLENFIELD) * column 1, line 55 - column 2, line 37; figures 1-5 *	1,5	
A	EP-A-0 472 270 (FURIGAS (U.K.) LIMITED) * abstract; figures 2,3 *	1	
A	DE-C-44 33 184 (BUDERUS HEIZTECHNIK GMBH)		TECHNICAL FIELDS SEARCHED (Int.Cl.6)
A	DE-A-23 29 592 (SADLER)		F23D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	23 October 1996	Phoa, Y

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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D : document cited in the application
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